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Date: November 16, 2000

Docket No.: 0104-0308P

Assistant Commissioner for Patents
Box PATENT APPLICATION
Washington, D.C. 20231

Sir:

As authorized by the inventor(s), transmitted herewith for filing
is a patent application applied for on behalf of the inventor(s)
according to the provisions of 37 CFR 1.41(c).

Inventor(s): MATTSSON, Ulf
DAS, Tamojit

For: A METHOD FOR ALTERING ENCRYPTION STATUS IN A RELATIONAL
DATABASE IN A CONTINUOUS PROCESS

Enclosed are:

X A specification consisting of 13 pages

X 1 sheet(s) of formal drawings

 Certified copy of Priority Document(s)

X Executed Declaration in accordance with 37 CFR 1.64 will follow

 A verified statement to establish small entity status under 37
CFR 1.9 and 37 CFR 1.27

X Preliminary Amendment

X Information Sheet

 Information Disclosure Statement, PTO-1449 with reference(s)

Other _____

The filing fee has been calculated as shown below:

LARGE ENTITY				SMALL ENTITY				
FOR	NO. FILED	NO. EXTRA	RATE	FEE		RATE	FEE	
BASIC FEE	***** ***** *****	***** ***** *****	***** ***** *****	\$710.00	or	**** **** ****	\$355.00	
TOTAL CLAIMS	15 - 20 =	0	x18 = \$	0.00	or	x 9 = \$	0.00	
INDEPENDENT	3 - 3 =	0	x80 = \$	0.00	or	x 40 = \$	0.00	
MULTIPLE DEPENDENT CLAIM PRESENTED <u>no</u>			+270 = \$	0.00	or	+135 = \$	0.00	
TOTAL \$				710.00		TOTAL \$		0.00

X The application transmitted herewith is filed in accordance with 37 CFR 1.41(c). The undersigned has been authorized by the inventor(s) to file the present application. The original duly executed patent application together with the surcharge will be forwarded in due course.

X A check in the amount of \$ 710.00 to cover the filing fee and recording fee (if applicable) is enclosed.

_____ The Government Filing Fee will be paid at the time of completion of the filing requirement.

_____ Please charge Deposit Account No. 02-2448 in the amount of \$ _____. A triplicate copy of this transmittal form is enclosed.

X Send Correspondence to: BIRCH, STEWART, KOLASCH & BIRCH, LLP
P. O. Box 747
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No fee is enclosed.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. 1.16 or under 37 C.F.R. 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By

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IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: MATTSSON et al.
Appl. No.: New Group:
Filed: November 16, 2000 Examiner:
For: A METHOD FOR ALTERING ENCRYPTION STATUS
IN A RELATIONAL DATABASE IN A CONTINUOUS
PROCESS

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

November 16, 2000

Sir:

The following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE CLAIMS:

Please amend the claims as follows:

Claim 3, line 1, delete "or 2"

Claim 14, line 1, delete "or 13"

REMARKS

Claims 1-15 are pending in the present application. The claims have been amended to remove the multiple dependencies and to place the application into better form prior to examination.

Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact James M. Slattey (Reg. 28,380) at the telephone number of the undersigned below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

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A METHOD FOR ALTERING ENCRYPTION STATUS IN A RELATIONAL
DATABASE IN A CONTINUOUS PROCESS

Field of invention

The present invention relates to a method for
altering encryption status in a relational database in a
5 continuous process reducing the need for taking the
database offline.

Background of the invention

In order to protect information stored in a
10 database, it is known to store sensitive data encrypted
in the database. To access such encrypted data you have
to decrypt it, which could only be done by knowing the
encryption algorithm and the specific decryption key
being used. The access to the decryption keys could be
15 limited to certain users of the database system, and
further, different users could be given different access
rights.

Specifically, it is preferred to use a so-called
granular security solution for the encryption of
20 databases, instead of building walls around servers or
hard drives. In such a solution, which is described in
the document WO 97/49211 by the same applicant, a
protective layer of encryption is provided around
specific sensitive data-items or objects. This prevents
25 outside attacks as well as infiltration from within the
server itself. This also allows the system manager to
define which data stored in databases are sensitive and
thereby focusing the protection only on the sensitive
data, which in turn minimizes the delays or burdens on
30 the system that may occur from other bulk encryption
methods.

Most preferably the encryption is made on such a basic level as in the column level of the databases. Encryption of whole files, tables or databases is not so granular, and does thus encrypt even non-sensitive data.

5 It is further possible to assign different encryption keys of the same algorithm to different data columns. With multiple keys in place, intruders are prevented from gaining full access to any database since a different key could protect each column of encrypted data.

10 However, there are problems with the previously known database encryption methods. Especially there is a problem when the system manager wants to change which columns that are to be encrypted and which are not to be encrypted, in a 7 days by 24 hours operational database, 15 since the database has to be taken out of operation when encryption is to be added or removed, or changed, to a column.

In most commercial applications accessibility is a critical issue. On the Internet, especially in web-based 20 applications, customers expect a service to be accessible when they want to use it.

Current encryption systems which encrypts data in databases, especially commercial relational databases, 25 has to be taken offline or be only partly available when adding or removing encryption on data.

Object of the invention

It is therefore an object of the present invention to provide a method which allows altering of encryption 30 status in a relational database in a continuous process, which significantly reduces or eliminates the need for making the database unavailable or only partly available, overcoming the above mentioned problems.

This object is achieved by means of a method 35 according to the appended claims.

Summary of the invention

According to the invention, a method for altering encryption status in a relational database in a continuous process, wherein at least one table of said database comprises at least one base area and at least one maintenance area, comprising the steps of: copying all records from said base area to said maintenance area; directing action of commands intended for said base area to said maintenance area; altering encryption status of said base area; copying all data records from said maintenance area to said base area; and redirecting action of commands to said base area.

Hereby a method is provided which significantly improves the uptime of a database system. With this method the database owner easily can alter encryption settings in the database while it is up and running. Since a rerouting of the access is provided, data will always be accessible. Thus, the security administrator (SA) can independently of any constraints regarding when the database has to be up add or remove encryption when it is needed. For example, if a security leak is found in a web-application such as an Internet store during rush hours, the management of that company would with previous solutions have had to decide whether to risk sales or risk that someone would intrude in their system gaining access to unencrypted data in the database. This is eliminated with the method according to the invention. Another advantage is that regular maintenance work can be performed during daytime, reducing the need for costly overtime since the maintenance personnel don't have to work when the database can be taken offline, which mostly is during night hours.

The term encryption status is to be understood as how to protect data elements in the base area, for instance whether or not the data elements are subject for encryption. In another embodiment it could also be understood as changing the encryption level, from strong

to weak. If the purpose is to remove encryption for data elements in the base area, the data elements are decrypted while they are copied to the maintenance area. Then, if the purpose is to add encryption to data elements, they are encrypted as they are copied to, or from, the maintenance area. Then, when the data elements are temporarily stored in the maintenance area, the settings could be changed for the base area.

The database which is described comprises one or more tables. Action of commands could for example be reading commands resulting in a read operation, or a write command resulting in a write operation.

Preferably, said step of directing is implemented in a trigger which is added to said table.

In an embodiment of the present invention said commands are data manipulation language (DML) statements.

In an embodiment of the present invention each base area in said database table have a corresponding maintenance area.

In an embodiment of the present invention the method comprises the further step of emptying said base area before said step of altering. Preferably this done by updating all the records of the column with NULL.

In an embodiment of the present invention the method comprises the further step of changing the data type of said base area. Preferably, this is changed to RAW.

In an embodiment of the present invention said base area is a first column of said table and said maintenance area is a second column of said table. However, the invention is not limited to this interpretation of an area, for example an area could comprise a set of columns.

According to another embodiment of the invention a method for altering encryption status in a relational database in a continuous process, wherein at least one table of said database comprises at least one base area, and for each base area a corresponding area, comprising

the steps of: activating encryption means for said corresponding column; directing action of commands intended for said base area to said maintenance area; copying all records from said base area to said corresponding area; and emptying said base area.

Hereby a method is provided which, in addition to the above mentioned advantages, allows continuous encryption on tables that have explicit locks i.e. row exclusive (RX) or share row exclusive (SRX) locks.

10

Brief description of the drawing

For exemplifying purposes, the invention will be described to embodiments thereof illustrated in the attached drawing, wherein:

15 Fig. 1 is a flow-chart illustrating an embodiment of a method according to the invention.

Description of a preferred embodiment

Referring to fig. 1, a method for altering encryption on column level in a relational database in a continuous process, without the need for taking the database offline according to a preferred embodiment of the invention is now to be described. In this embodiment the altering is performed on column level.

25 The tables I and II below illustrates an example of a database table, "tab", for which encryption is to be added to a column. Table I describes the structure of the database table "tab" and Table II is an example of the contents in such a table.

30

Data element	Data type	Value	Comment
cust_id	NUMBER	NOT NULL	Primary key
name	VARCHAR2 (64)	NOT NULL	
date_of_birth	DATE	NOT NULL	
user_name	VARCHAR2 (32)	NOT NULL	
password	VARCHAR2 (32)	NOT NULL	To be encrypted
maint	VARCHAR2 (32)	NULL	

Table I

cust_id	name	date of birth	user_name	password	maint
1001	MAX	19910101	MNN	abc	NULL
1002	MARTIN	19920202	MKR	cdf	NULL
1003	JOHAN	19930303	JON	ghi	NULL
1004	MARIE- LOUISE	19940404	MLA	jkl	NULL

Table II

The method comprises a first step S1, wherein data
 5 is copied from the base column "password" to the
 maintenance column "maint". The contents of "tab" after
 the step S1 are shown in Table III.

cust_id	name	date of birth	user_name	password	maint
1001	MAX	19910101	MNN	abc	abc
1002	MARTIN	19920202	MKR	cdf	cdf
1003	JOHAN	19930303	JON	ghi	ghi
1004	MARIE- LOUISE	19940404	MLA	jkl	jkl

Table III

10

Preferably, if needed, the method contains a step,
 which checks whether the column "password" is nullable,
 i.e the column does not have a NOT NULL constraint. Then
 the column is altered to be nullable.

15 In another step S2 a trigger is added. The object of
 the trigger is to direct all commands aimed at the base
 column to the maintenance column, i.e. a synchronization
 function. Thus, when a user for example sends a update
 command for the base column, this command is directed to
 20 the maintenance column. In order to overcome problems
 during copying and activation of the trigger, the trigger
 could be built up from several steps. For instance, it
 could first synchronize the base and the maintenance
 column, then when the contents are identical, stop
 25 updating the base column at the same time let the
 maintenance column take over the actions taken on the
 base column. Preferably the copying of the records from

the base column is performed simultaneously with the addition of the trigger.

In another step S3, the base column "password" is emptied. For instance, this could be performed by updating the base column with NULL. Preferably, if it is required by the later applied encryption, the method comprises the further step S4, wherein the table is altered in order to change the base column data type to the data type RAW. The present structure and contents of "tab" is described in tables IV and V, respectively.

Data element	Data type	Value	Comment
cust_id	NUMBER	NOT NULL	Primary key
name	VARCHAR2(64)	NOT NULL	
date_of_birth	DATE	NOT NULL	
user_name	VARCHAR2(32)	NOT NULL	
password	RAW	NULL	To be encrypted
maintenance	VARCHAR2(32)	NOT NULL	

Table IV

cust_id	name	date_of_birth	user_name	password	maint
1001	MAX	19910101	MNN	NULL	abc
1002	MARTIN	19920202	MKR	NULL	cdf
1003	JOHAN	19930303	JON	NULL	ghi
1004	MARIE- LOUISE	19940404	MLA	NULL	jkl

Table V

15

Then, the step S5 of activating encryption means is performed. Thus, all data written to the base column "password" will now be written in encrypted form. The means for encryption could be a standard software or hardware, for example a apparatus with a DES algorithm. The data is read from the maintenance column and processed by encryption means. The encryption could be either symmetrical or asymmetrical, for example DES or RSA respectively.

25

After step S5, the records from the maintenance column are copied to the base column through the encryption means in step S6. Thus, the contents of the

base column "password" is now stored in an encrypted form.

Then the trigger is removed in step S7. This is done in such a manner that synchronization problems are overcome. Preferably the copying of the records from the maintenance column is performed simultaneously with the removal of the trigger.

Since the maintenance column now contains unencrypted data, it is important that this column is emptied, which is performed in step S8. This can be performed by either updating the column with NULL or writing a random value into the column. Then this example table, "tab", will have the contents as shown in table VI.

cust_id	name	date_of_birth	user_name	password	maint
1001	MAX	19910101	MNN	7je	NULL
1002	MARTIN	19920202	MKR	skj	NULL
1003	JOHAN	19930303	JON	9fj	NULL
1004	MARIE- LOUISE	19940404	MLA	xjr	NULL

Table VI

In order to let the altering of the table have effect on views, the views have to be recreated after each ALTER of a table.

An alternative embodiment will now be described. The above mentioned embodiment is used under the presumption that there are not any table locks (RX/RSX = Row Exclusive/Row Share Exclusive) on the table. In the case of such database locks, additional maintenance columns have to be added in advance. This is preferably performed during installation or planned maintenance, and has not to be done when the actual adding or removing of encryption takes place. Thus, there will be created a maintenance column for each column, which is not currently encrypted. The method according to the alternative embodiment is similar to the preferred

embodiment described above and comprises of the steps:
activating encryption means for the maintenance columns
corresponding to the base column, which is to be
encrypted; adding a trigger to the table, which transfers
5 action of data manipulation language (DML) statements
intended for the base column to the maintenance column;
copying all records from the base column to the
corresponding maintenance column through the encryption
means; and emptying said base column.

10 The invention has been described above in terms of a
preferred embodiment. However, the scope of this
invention should not be limited by this embodiment, and
alternative embodiments of the invention are feasible, as
should be appreciated by a person skilled in the art. For
15 example, if a column has a constraint indicating that a
value of a column can not be NULL, and this column is to
be encrypted, the constraint has to be removed
temporarily. Also, the method could also be used for
changing the strength of encryption on an chosen area or
20 when keys are to be changed, or when data is to be
reencrypted.

Such embodiments should be considered to be within
the scope of the invention, as it is defined by the
appended claims.

CLAIMS

1. A method for altering encryption status in a
5 relational database in a continuous process, wherein at
least one table of said database comprises at least one
base area and at least one maintenance area, comprising
the steps of:
- copying all records from said base area to said
10 maintenance area;
 - directing action of commands intended for said base
area to said maintenance area;
 - altering encryption status of said base area;
 - copying all data records from said maintenance area
15 to said base area; and
 - redirecting action of commands to said base area.
2. A method according to claim 1, wherein said step
of directing is implemented in a trigger which is added
20 to said table.
3. A method according to claim 1 or 2, wherein said
commands are data manipulation language (DML) statements.
- 25 4. A method according to claim 1, wherein each base
area in said database table have a corresponding
maintenance area.
5. A method according to claim 1, comprising the
30 further step of:
- emptying said maintenance area.
6. A method according to claim 1, comprising the
further step of:
- 35 emptying said base area before said step of
altering.

7. A method according to claim 6, wherein said step of emptying the base area comprises the step of:
 updating all the records of the column with NULL.

5 8. A method according to claim 1, comprising the further step of.
 changing the data type of said base area.

9. A method according to claim 8, wherein the data
 10 type of the base column is changed to the data type RAW.

10. A method for altering encryption status in a relational database in a continuous process, wherein at least one table of said database comprises at least one
 15 base area, and for each base area a corresponding area, comprising the steps of:
 activating encryption means for said corresponding column;
 directing action of commands intended for said base
 20 area to said maintenance area;
 copying all records from said base area to said corresponding area; and
 emptying said base area.

25 11. A method according to claim 10, wherein said base area is a first column of said table and said maintenance area is a second column of said table.

12. A method for altering encryption status in a
 30 relational database in a continuous process, wherein at least one table of said database comprises at least one base column and at least one maintenance column, comprising the steps of:
 copying all records from said base column to said
 35 maintenance column;
 directing action of commands intended for said base column to said maintenance column;

altering encryption status of said base column;
copying all data records from said maintenance
column to said base column; and
redirecting action of commands to said base column.

5

13. A method according to claim 12, wherein said
step of directing is implemented in a trigger which is
added to said table.

10

14. A method according to claim 12 or 13, wherein
said commands are data manipulation language (DML)
statements.

15

15. A method according to claim 12, wherein each
base column in said database table have a corresponding
maintenance column.

ABSTRACT

A method for altering encryption status in a
5 relational database in a continuous process, wherein at
least one table of said database comprises at least one
base area and at least one maintenance area, comprising
the steps of: copying all records from said base area to
said maintenance area; directing action of commands
10 intended for said base area to said maintenance area;
altering encryption status of said base area; copying all
data records from said maintenance area to said base
area; and redirecting action of commands to said base
area.

15

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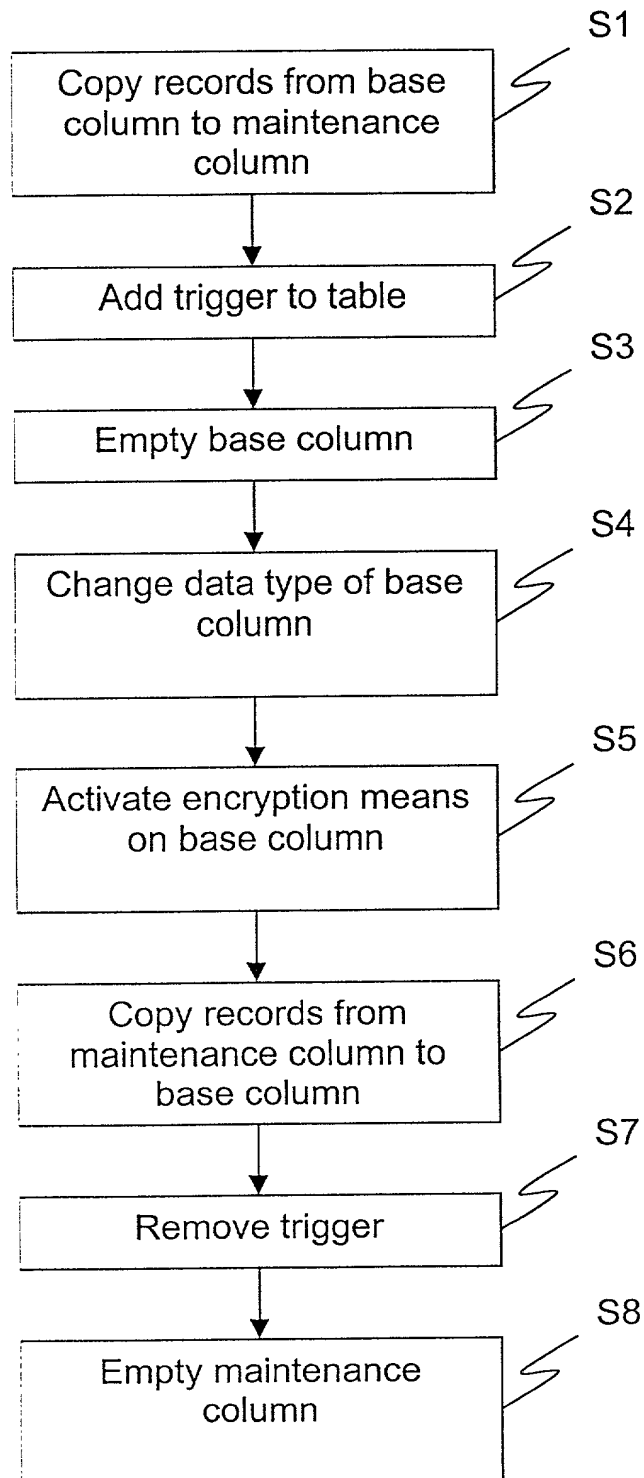


Fig. 1